Federal Cybersecurity Apprenticeship Resource Guide

Co-developed by the National CyberWatch Center™ Working Group on Federal Cybersecurity Apprenticeships

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NATIONAL CENTER



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1. Introduction to Apprenticeships

a. What is an apprenticeship program?

There are many definitions of an apprenticeship program; the National Initiative for Cybersecurity Education (NICE) of the National Institute of Standards and Technology (NIST) describes it as an important mechanism for building a steady pipeline of job-ready talent and providing entry points for those switching careers, without advanced degrees, or re-entering the field (an informative one-pager can be found here https://www.nist.gov/document/niceapprenticeshiponepageroct312017pdf).

There are major benefits for apprentices and employers alike; for the student apprentice, they include:

- Earn wages and an industry-recognized credential
- Train with employer and position yourself for full-time employment
- Gain real world job skills that can include earning college credits and/or industry certifications

For the employer, they include:

- Develop highly skilled talent that matches your needs
- "Try before you buy" ensure good cultural and skill fit
- Low cost to hire and high return on investment
- Low turnover and improved employee retention
- Opportunities for tax credits and employee tuition benefits in some states

b. Are cybersecurity apprenticeship programs used in federal agencies?

The surprising answer is that while apprenticeships are extensively used in private industry in the cybersecurity workforce crunch for talent, there are no known programs in federal agencies. Given the growing importance of cybersecurity, as well as the dearth of skilled talent, this Resource Guide intends to encourage the understanding and use of the apprenticeship model in the federal agency space.

c. Why do apprenticeships matter?

Quality of knowledge transfer: Since apprenticeships include both academic and/or certification training along with OJT, the quality of knowledge transfer is far superior from that of a traditional book-learning experience. Each apprentice is paired with a "journey person" or mentor who works

with the apprentice while the learning experience unfolds, ensuring a real alignment with the realities of the job requirements and the skills needed to carry them out.

Earn while you learn: The financial hardships and large student debt of today's student are well documented. Since the apprenticeship model includes a job component under which the learner is compensated for time on the job, it requires far fewer financial resources.

Racial equity: The financial model of apprenticeships described above opens up pathways to jobs and careers to elements of society that have been heretofore locked out. Cybersecurity has a variety of job classifications, and everyone can find a niche irrespective of prior preparation as they enter an apprenticeship program.

d. What is an apprenticeship framework that can scale and be transferred?

The state of California is one of the most advanced and aggressive users of the apprenticeship model. Their approach to identifying candidates and creating a pathway for them is shown in Figures 1 and 2.



Figure 1. Talent pipeline for apprenticeships



Figure 2. Apprenticeship framework

2. What Do Current Apprenticeships Look Like?

Several examples of apprenticeships have been assembled from a variety of institutions; while not specifically for cybersecurity apprenticeships in feral agencies (the topic of this Resource Guide), they give a sense of the potential, as well as the implementation approaches of this promising way to fill cybersecurity personnel gaps.

Howard Community College in Partnership with AT&T



Howard Community College IT Apprenticeships with AT&T and Partner

A solution to the cyber skills shortage in Maryland

Howard Community College's IT Apprenticeship, in partnership with AT&T and partner, is Maryland's only IT apprenticeship program that enables individuals to earn a security clearance while they prepare to succeed in an IT profession through academics, certification, and on the job training. The typical duration of such apprenticeships is 18-24 months, during which time the apprentices typically attend classes two nights per week. When the apprentices are hired, they start working part-time in an uncleared environment for 20 hours per week. During the apprenticeship the students complete CompTIA certifications (Network+ and Security+) and earn 18-24 academic credits. There are currently 3 occupational tracks in the program: IT Field Support Specialist, Network Field Support Specialist, and Information Systems Security Specialist; coursework depends on which track the applicant is accepted into. As soon as their security clearance is processed, the apprentices transition to full-time work. The apprentices also work with a mentor throughout the program. This apprenticeship is registered with both the State of Maryland and the US Department of Labor.

Requirements include being at least 18 years or older by the time the program starts, U.S. Citizenship, and ability to obtain a security clearance; the ability to lift 50 pounds, and demonstrated enrollment and success in computer technology coursework. Prior completion of more than 50% of the approved coursework disqualifies an applicant for the apprentice because they do not have the balance of the coursework and on the job training.

Further information may be found at https://howardcc.edu/apprenticeships or by emailing apprentice@howardcc.edu

Rightvarsity Technologies, LLC

Rightvarsity	Rightvars	6 San Jose CA 95151, Phone:	gies, LLC 408-649-5872
Tech		Certified	200-0-27-3072
	SBE DBE	IBN W/BE	
		Women's Business Enterprise	
RIGHTVARSITY TECH	INOLOGY WORKFOR	CE IMMERSION APPRE	NTICE SHIP
Rightvarsity Technologies development, contemporary I' Occupational Information Ne Labor/Employment and Train align with the National Initiati Framework), published by the of Cybersecurity Career S tud with the Health IT Workforce Health Information Technol universities and adult educa sometimes qualify some of th to obtain an industry-recogniz	provides ON-DEMAND v l'apprenticeship training. To e etwork (O*NET) is develop ing Administration (USDOL/ ve for Cybersecurity Education National Institute of Standar ies (NICCS.) Furthermore, all a Curriculum Components pro- ogy (ONC) training. We wand ion centers to enrich our ce e participant's learning experi- ed certi fication.	vorkforce capacity building, e ensure employability, each curricu ed under the sponsorship of the ETA). The curriculum for most of on (NICE) Cybersecurity Workfor ds and Technology (NIST) under 1 the training for our healthcare IT ublished by the Office of the Nat vork in partnership with local ompetency-based training, on-th lence for credit. Ultimately, each p	employment training lumis in line with the U.S. Department of 5the IT pathways also ce Framework (NICE the National Initiative T pathways are in line ional Coordinator for community colleges, e-job experience and participant is prepared
OUR REGIS TERED APPRE Application/Software Cyber Security Analy Helpdesk Technicians IT Project Managers, Information Assuranc Health IT Specialists.	NTICESHIP PATHWAYS Developers, sts, , e Specialists,	 Clinical Document Imp Health Information Dat Health Information Ma Analysts, Health Information Ma 	rovement Specialists, a Analysts, nagement Business nagement Coders
WHO WE SERV E Our target population include ON-DEMAND training, On-ti New Hire Training fo Retraining and proact Transitional Training Entrepreneurial Train Upscale and upskill fi Organizations are ab of candidates or utiliz who have interest in of including HEALTHC	individuals, public or private he-Job training (OJT) apprent r unemployed persons ive succession upskilling for for Veterans ing for owners of a small bu or everyone (especially, dislo le to build their capacity via s e their existing talent in the p contemporary CYBERSECUE ARE IT (Tele-HEALTH) ski	companies seeking skilled IT emp ticeship training for incumbent workers siness ocated workers) staff augmentation by selecting fix rogram. We work with MULTIPI RITY and other ADVANCED TE Ils training for their existing empli	ployees. We provides om our diverse pool E EMPLOYERS CHNOLOGY oyees.
BENEFITS TO EMPLOYER Take advantage of a s Identify a good fit fro Increase productivity Customized training a Get job applicants pre Improve your current Use on-site facilities f Follow up mentoring Gain recognition by f Join our multiple emp Receive tax deduction OUR INTEGRATED CAPACITY	easoned training provider in i m a group of elite IT interns and employee retention rate nd curriculum support -screened employees job skills for recruiting and interviewing coaching for up to 3 months he Department of Labor loyers to subsidize your emp is while giving back to the co BUILDINGIMMERSION APP1	the ETPL g job applicants after employment loyee training cost mmuni ty RO ACH	
Continuous Assessment, Co Recruitment	mmunication, Supervised Job Search, coa sess & Train	ching, Mentoring, Retention & other supportive Assign & Follow Up Ob Place	Services. serve & raluate
Pre-apprent	iceship	Apprenticeship	

Community Initiative Center of Excellence for Secure Software (CICESS) Historically Black Colleges and Universities (HBCU) Program



Community Initiative Center of Excellence for Secure Software (CICESS)

Ishpl Information Technologies, Inc. provides full spectrum cybersecurity services to the Department of Defense and other agencies of the federal government. The CICESS Initiative demonstrates Ishpl's commitment to solve IT and cyber security skills shortage and increase the diversity of the IT and cybersecurity workforce.

Basic Structure

- CICE SS is an industry/government/academic collaborative effort to design and launch degree apprenticeships at scale
- The goal is to provide a readily employable workforce capable of developing software that is secure from cyberattacks
- Innovative award-winning dual model registered apprenticeship program combining enrollment in a degree program at an educational institution with on-the-job training/mentoring at participating employer
- Employers and educational partners jointly determining their respective roles and responsibilities in the dual model
- Standardized curriculum mapped to competencies, knowledge, skills, and abilities in the NICE Framework for secure software developer work role
- Offering an economically feasible career path way in which employers provide up to 2,000 hours of on-the-job training and mentoring
- Ensuring that apprentices receive stackable and verifiable credentials through certification by an intermediary

To-date and Future Plans

- Inaugural cohort started in Fall 2015 with 7 students at Illinois Central College (ICC) in Peoria, IL
- Most recent cohort started in Spring 2019 with 5 students at the Alamo Colleges in San Antonio, TX
- Current focus is to partner with Historically Black Colleges and Universities to provide career pathways to women, minorities, and veterans

Employer Benefits

- Better match between secure software development jobs and required competencies, knowledge, skills, and abilities
- High success rate in sourcing qualified candidates with the proven capabilities and competencies required for secure software development
- High retention rates of skilled workers
- Proven successful work-based learning model tailored to augment existing skills formation models and meet requirements defined by industry

Job Seeker Benefits

- Income earned while acquiring degree along with certifications to demonstrate competencies
- Prospect of fulltime employment with the mentoring employer upon successful completion of the apprentices hip

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US Department of Labor (DoL) Apprenticeship Profiles

Federally-recognized Apprenticeship programs are a proven approach for recruiting, training, and retaining workers in high-skilled careers in the public and private sectors. Apprenticeship can be used by federal agencies as an effective talent management strategy. Apprenticeship can also be used to expand and sustain federal grants and contracts in order to help American workers and businesses. The U.S. DoL is working with partner agencies to promote Apprenticeship programs through three key strategies: personnel, policy and partnerships, and procurement.

Personal

Apprenticeship is a proven strategy for on-boarding new workers and up-skilling current employees and can be used to train the federal workforce to the unique needs of each agency

 Pathways through Apprenticeship. The Office of Personnel Management and DoL have developed a Pathways through Apprenticeship pilot program, through which agencies receive support in designing one-year apprenticeship programs. The pilot is targeted to students in accredited high schools, community and technical colleges, and four-year universities. apprenticeshipusa.workforcegps.org/resources/2016/08/25/13/04/Pathways_Through_Apprenticeship_Resource_Page

SPOTLIGHT ON SUCCESS

The U.S. Department of Agriculture (USDA) has established an apprenticeship pilot program to train veterans to become the next generation of USDA agricultural commodity graders

- Military Apprenticeships. The https://militarybenefits.info/united-services-military-apprenticeship/ is "all in" with apprenticeship training, with 95,000 apprentices in the Coast Guard, Marine Corps, and Navy. In addition to providing active-duty service members with the opportunity to increase their skills, the program expands employment opportunities for service members when they return to civilian life. https://militarybenefits.info/united-services-military-apprenticeship/
- Public Service Apprenticeships. Federal agencies across the government are using apprenticeship as a strategy to train new and upgrade existing staff - from Railroad Safety Inspectors at the Department of Transportation, to Health Informatics staff at the Centers for Disease Control, and machinists at the U.S. Mint. www.doleta.gov/oa/federal-apprenticeships/

Policy and Partnerships

Apprenticeship provides many opportunities for collaboration and policy alignment across agencies and federal programs, and DoL has developed strategic partnerships to promote apprenticeship programs:

SPOTLIGHT ON SUCCESS

To advance her career, Kelli Mumphrey started an Apprenticeship program with the Employment and Training Administration (ETA) in March 2016. Her apprenticeship allowed her to complete several rotations in different areas of the agency's mission. With a family of four, Ms. Mumphrey skillfully balanced her apprenticeship, Naval Reserve responsibilities, and working on a Master's degree in Management. A week after receiving her Master's degree, Ms. Mumphrey was offered a permanent position as a Workforce Development Specialist at ETA. She sees this position as her "dream job," through which she can provide meaningful contributions in a profession that has a positive impact on the lives of American workers.

- Apprenticeship Community College Consortium. This is a national network of post-secondary institutions, employers, labor organizations, and others working together to allow apprenticeship program graduates to accelerate completion of post-secondary degrees at member schools. www.doleta. gov/oa/racc.cfm
- *Youth Apprenticeship.* DoL and the Department of Education jointly released a framework on apprenticeship for High School students. wdr.doleta.gov/directives/corr_doc.cfm?DOCN=4799
- Workforce Innovation and Opportunity Act (WIOA). WIOA, passed in 2014, has a strong emphasis on apprenticeship training as a work-based learning strategy that provides career pathways for workers and a skilled workforce for businesses. DoL released guidance on the opportunities for apprenticeship through WIOA programs. https://wdr.doleta.gov/directives/corr_ doc.cfm?DOCN=9125

SPOTLIGHT ON SUCCESS

The Apprenticeship Community College Consortium, launched in 2014 by the U.S. Departments of Labor and Education, already includes one-fourth of the nation's community colleges, and 976 apprenticeship training centers as partners.

- *Veterans and Apprenticeship.* To increase apprenticeship opportunities for veterans, the Veterans' Administration is collaborating with DoL to streamline the approach for veterans to access their GI Bill funding for costs associated with apprenticeship training.
- Policy Research. The Department of Commerce partnered with DoL to develop case studies demonstrating the return on investment of apprenticeship programs for businesses. https://strategies. workforcegps.org/resources/2017/06/02/20/15/The-Benefits-and-Costs-of-Apprenticeship-A-Business-Perspective

Future strategies for apprenticeship opportunities through federal policy and partnerships include promoting greater use of the Department of Defense SkillsBridge program for apprenticeship, enhancing the alignment of Career and Technical Education with apprenticeship when the Perkins Act is reauthorized, and reviewing policy guidance for opportunities to incentivize Apprenticeship programs.

Procurement

Emphasizing apprenticeship in contracts and grant solicitations can help federal agencies leverage their purchasing power. The Davis-Bacon Act, administered by DoL, allows workers in apprenticeship programs to be employed on federal projects at a lower wage rate than that listed in the contract wage determination:

- Department of Housing and Urban Development (HUD). HUD is using Section 3 contracts to advance Registered Apprenticeship and YouthBuild in public housing. portal.hud.gov/hudportal/documents/huddoc?id=HUD-DOL_Factsheet.pdf
- Department of Health and Human Services. Health Profession Opportunity Grants require grantees to partner with their state's apprenticeship office to promote apprenticeship opportunities and career pathways for TANF recipients. www.acf.hhs.gov/ofa/resource/apprenticeship-paper
- *Department of Agriculture.* Federally Recognized Apprenticeship and pre-apprenticeship are included in the grant solicitations for the Supplemental Nutrition Assistance Program (SNAP).
- The Federal Resources Playbook. This guide describes the array of federal programs that can be used to support Apprenticeship programs, including WIOA, Pell Grants, the GI Bill, and others. www.doleta.gov/oa/federalresources/playbook.pdf

SPOTLIGHT ON SUCCESS

The U.S. Department of Transportation's Women in Trucking Roundtable brought together key transportation industry groups to discuss how apprenticeship can help meet the challenge of recruiting women into trucking occupations.

Future opportunities in this area include working with federal agencies to examine their contracts and grant solicitations to include an emphasis on apprenticeship, and looking for opportunities to connect agencies' stakeholders to DoL's sector-based work called the Sectors of Excellence in Apprenticeship (www.dol.gov/sites/default/files/SEAsOverviewFactSheet.pdf).

Learn More About Apprenticeship

To learn more about Apprenticeship and federal partnership efforts to expand Apprenticeship programs:

- www.dol.gov/apprenticeship
- Apprenticeship.USA@dol.gov
- 202-693-3813

3. Current Apprenticeship

The federal government currently takes advantage of the apprenticeship model in many organizations and specific work environments. In addition, several states have also moved forward aggressively in the same area. References that can provide context, background information and an ample network that can help a federal or state Human Resources or hiring manager have been assembled in this section.

a. Federal Apprenticeship Programs

Federal Agency	Occupation	Active Apprentices
NASA Langley Technician Apprentice Program	Electrical Engineering Technician (Research Facilities and Testing) Electronics Engineering Technician (Aerospace Electronics Research Dev.) Mechanical Engineering Technician (Aerospace Machining Development) Mechanical Engineering Technician (Aerospace Model Development) Mechanical Engineering Technician (Research Facilities and Testing)	New Program
Department of Veterans Affairs	Police Officer	12
Centers for Disease Control and Prevention (CDC)	Public Health Informatician	18
Dept. of Labor, Employment and	Workforce Development Specialist	7
Training Administration	Workforce Development Analyst	-
Dept. of Labor, Employment and Training Administration, Office of Apprenticeship	Apprenticeship and Training Representative	5
Dept. of Labor, MSHA	Mine Inspector (Gov) Metal-Nonmetal Mine Inspector (Gov) Coal	55
Dept. of Treasury, Bureau of Engraving and Printing	Plate Maker	1
Dept. of Treasury, U.S. Mint	Tools and Die Maker	7
(Colorado, California, Pennsylvania)	Sprinkler Fitter Machine Operator	
U. S. Coast Guard	Electrician, Maintenance	1
DoD Navy, Fleet Readiness Center Mid Atlantic and Affiliates	Aircraft mechanic, plumb & hydraulic Electrician, aircraft Electrician, maintenance Machinist (alternate title: precision machinist) Machinist, outside (ship) Sheet metal worker Welding (existing title: welder, combination)	19
DoD Navy, Naval Consolidated Brig, Miramar	Cook (Any Ind) (Alternate Title: Nutrition Care Specialist)	21
DoD Navy, NAVFAC Southwest	Boiler Operator Carpenter Cement Mason Construction Equipment Mechanic Electrician (Alternate Title: Interior Electrician) Heating & Air-Conditioner Install/Ser Line Erector (Power-Line Distribution Erector) Maint Mechanic (Any Ind) (Alternate Title: Industrial Maintenance Mechanic) Pipe Fitter (Construction) Rigger (Ship & Boat Bldg) Sheet Metal Worker Water Treatment Plant Operator	67

	Welder, Combination	
DoD Navy, Pearl Harbor Naval	Calibration Laboratory Technician	884
Shipyard & IMF	Canvas Worker	
	Composite Plastic Fabricator (Existing Title: Insulation Worker)	
	Diesel Mechanic (Alternate Title: Power-Generation Equipment Repairer)	
	Electrician (Ship & Boat)	
	Electronics Mechanic	
	Electronics Technician	
	Inspector, Metal Fabricate	
	Machinist (Alternate Title: Precision Machinist)	
	Machinist, Outside (Ship) (0300)	
	Maint Mechanic (Any Ind) (Alternate Title: Industrial Maintenance Mechanic)	
	Painter (Existing Title: Painter, Shipyard)	
	Pipe Fitter (Ship & Boat)	
	Plastic Process Technician	
	Refrigeration Mechanic (Any Ind)	
	Repairer, Handtools	
	Rigger	
	Sheet Metal Worker	
	Shipfitter (Ship & Boat)	
	Shipwright (Ship & Boat)	
	Welder, Combination	
DoD Navy, Puget sound Naval	Canvas Worker	1046
Shipvard	Composite Plastic Fabricator	1010
	Diesel Mechanic (Alternate Title: Power-Generation Equipment Repairer)	
	Electrician (Alternate Title: Interior Electrician)	
	Electrician (Shin & Boat)	
	Electrician (Water Trans)	
	Electrician Maintenance	
	Electromechanical Technician	
	Electronics Mechanic	
	Electroplater	
	Eabric Worker	
	Machine Benairer Maintenance	
	Machinist	
	Machinist Outside (Shin)	
	Maint Mechanic (Any Ind)	
	Mechanic Industrial Truck	
	Non-Bat Registered Dot's	
	Non-Destructive Tester	
	Painter (Existing Title: Painter Shinyard)	
	Painter (Const)	
	Patternmaker, Metal	
	Pipe Fitter (Construction)	
	Pipe Fitter (Ship & Boat)	
	Plastics Fabricator	
	Plater	
	Rigger D	
	Sheet Metal Worker	
L		

	Shipfitter (Ship & Boat)	
	Shipwright (Ship & Boat)	
	Tool Maker	
	Welder, Combination	
DoD Navy; PSNS & IMF Detachment		58
San Diego		
DoD, Navy, - China Lake Naval	Calibrator (Military)	16
Warfare Center	Electrician, Maintenance	
	Electromechanical Technician	
	Heating & Air-Conditioner Install/Ser	
	Machinist (Alternate Title: Precision Machinist)	
	Maint Mechanic (Any Ind)	
	Material Coordinator	
	Mech Engineering Technician	
	Plastic Process Technician	
	Quality Control Technician	
DoD, Navy, Trident Refit Facility	Canvas Worker	169
	Composite Plastic Fabricator	
	Electrician (Alternate Title: Interior Electrician)	
	Electronics Mechanic	
	Instrument Repairer	
	Machine Repairer, Maintenance	
	Machinist (Alternate Litle: Precision Machinist)	
	Nachinist, Outside (Ship)	
	Operating Engineer Deinter (Const)	
	Dino Fitter (Chin & Roat)	
	Plactice Enhicator	
	Refrigeration Mechanic (Any Ind)	
	Rigger	
	Sheet Metal Worker	
	Shipfitter (Ship & Boat)	
	Shipwright (Ship & Boat)	
	Tile Setter	
	Welder, Combination	
DoD, U.S. Army Corps Engineers	Electrician, Powerhouse	24
(Montana, North Dakota, Oregon,	Electronics Mechanic	
	Power-Plant Operator	
	Powerhouse Mechanic	
United States Department of	Machinist	0
Defense - Fort Meade		
U.S. Department of Transportation,	Railroad Safety Inspector	5
Federal Railroad		
Federal Bureau of Prisons	Animal trainer	10,550
	Automobile mechanic (alternate title: light-wheel vehicle mechanic)	
	Automotive technician specialist	
	Automotive technician specialist (alternate title: light-weight vehicle mech)	
	Baker (bake produce)	

Baker (hotel & restaurant)	
Barber	
Bindery worker	
Biomedical equipment technician	
Boiler operator	
Bricklayer (construction)	
Cabinetmaker	
Career development technician	
Carpenter	
Carpenter, maintenance	
Chaplain service support (military only)	
Computer-peripheral-equipment-op	
Construction craft laborer	
Cook (any ind) (alternate title: nutrition care specialist)	
Cook (hotel & restaurant)	
Correction officer	
Customer service represent	
Dental assistant (alternate title: dental specialist)	
Direct support specialist	
Drafter, mechanical	
Drafter, structural	
Dry cleaner	
Education and training (military only)	
Elect-motor & gen assembler	
Electrical technician	
Electrician (alternate title: interior electrician)	
Electrician, maintenance	
Electronics tester	
Electronics utility worker	
Environmental control syst. Instal/services (hvac)	
Farm worker, general i	
Fish hatchery worker	
Health care sanitary technician	
Heating & air conditioning mechanic & installer	
Heating & air-conditioner install/ser	
Heating, ventilation, air conditioning (ex. Lit: heating air cond. Inst/ser)	
Horticulturist	
Housekeeper, com, res, ind	
Jacquard-Ioom weaver	
Landscape gardener	
Landscape management technician	
Legal secretary	
Luulli lixei Machina anaratari	
Machinist (alternate title), provision machinist)	
Maint mechanic (any ind) (alternate title, inductrial maintenance mechanic)	
Maint mechanic (any inu) (diterriate title: muustrial mainteriance mechanic) Maintenance repairer, huild	
Maintenance repairer, pullu Maintenance repairer, industrial	
ואמוונכוומונכ וכאמו כן, וועטגוומו	

	Manager, food service	
	Material coordinator (alt titles: automated logistical /unit supply specialists)	
	Millwright	
	Nurse assistant	
	Office manager/admin services	
	Offset-press operator i	
	Orthotics technician	
	Painter (const)	
	Painter (professional and kindred)	
	Painter, hand (any ind)	
	Patternmaker (textiles)	
	Peer specialist (bureau of prisons only)	
	Photographer, lithographic	
	Physical therapy aide	
	Pipe fitter (construction)	
	Plumber	
	Power-plant operator	
	Powerhouse mechanic	
	Prosthetics technician	
	Purchasing agent	
	Quality control inspector	
	Quality control technician	
	Recreation assistant	
	Recycling and reclamation worker (prisons only)	
	Recycling coordinator (prison only)	
	Refrigeration mechanic (any in	
	Sewing machine repairer	
	Shop tailor	
	Small engine mechanic	
	Stationary engineer	
	Stationary engineer-power house (existing title: stationary engineer)	
	Teacher aide i	
	Tool and die maker	
	Upholsterer	
	Wastewater-treatment- plant operator (alternate title: water treatment specialist)	
	Welder-fitter	
	Welder, arc	
	Welder, combination	
	Welding technician	
DoD Navy, Fleet Readiness Center	Aircraft armament mechanic	110
Southwest-North Island	Aircraft mechanic, electrical	
	Aircraft mechanic, plumb & hydraulic	
	Airframe & power plant mechanic	
	Assembler, aircraft structures	
	Elect-sales & service technician	
	Electrician, aircraft	
	Electrician, maintenance	
	Electronic industrial control mechanic (existing title: electromechanical tech)	
	Electronics mechanic	

	Fabricator-assembler metal prod	
	Instrument mechanic (any ind)	
	Machinist (alternate title: precision machinist)	
	Machinist, outside (ship)	
	Non-destructive tester	
	Painter, trans equipment	
	Pneudraulic systems mechanic	
	Precision assembler	
	Production machinery mechanic (existing title: machine repairer)	
	Sheet metal mechanic (existing title: sheet metal worker)	
	Welder (existing title: welder, combination)	
Grand Coulee Power Office	Hydroelectric-Station Operator	0
	Powerhouse mechanic	
	Electrician Powerhouse	
Job Corps	Cook	12
	Automotive technician specialist	
	Cable television installer	
	Nurse assistant certified (existing title: nurse assistant)	
	Psychiatric nursing technician	
National Interagency Joint	Fire fighter specialist wildland	713
Apprenticeship Program (Wildland		/15
Firefighter)		
Office of Escilities Management and	Electrician	0
Reliability	Mason (Coment Mason)	0
Reliability	Dlumbor	
(Smitheonian Institution)	Hulliber	
(Smithsonian Institution)	Convex worker	1049
Portsmouth Navai Shipyard	Canvas worker	1948
	Composite plastic labricator (existing title: Insulation worker)	
	Crane electrician (existing title: electrician (snip & boat))	
	Crane mechanic (existing title: mechanic, industrial truck)	
	Diesei mechanic (alternate titie: power-generation equipment repairer)	
	Electrician (alternate title: interior electrician)	
	Electronic industrial control mechanic (existing title: electromechanical tech)	
	Electronics mechanic	
	Fabric worker (existing title: patternmaker, all-around)	
	Heating & air-conditioner install/ser	
	Heavy forger	
	Joiner (ship & boat bldg)	
	Line erector (power-line distribution erector)	
	Machinist (alternate title: precision machinist)	
	Machinist, outside (ship)	
	Maint mechanic (any ind) (alternate title: industrial maintenance mechanic)	
	Marine electrician (existing title: electrician [ship & boat])	
	Marine machinery mechanic (existing title: machine repairer, maintenance)	
	Marine pipefitter (existing title: pipe fitter [ship & boat])	
	Metal fabricator	
	Non-destructive tester	
	Painter (const)	
	Painter (existing title: painter, shipyard)	

	Painter, hand (any ind)	
	Pipe fitter (construction)	
	Plastics fabricator	
	Production machinery electrician (existing title: electrician, maintenance)	
	Production machinery mechanic (existing title: machine repairer)	
	Rigger	
	Sheet metal worker	
	Shipfitter (ship & boat)	
	Shipwright (ship & boat)	
	Temporary services electrician (existing title: electrician (ship and boat))	
	Temporary services pipefitter (existing title: pipe fitting and/or plumbing)	
	Tool maker	
	Utilities systems repair operator (dry docks) (existing title: pipe fitter (ship and boat))	
	Welder, combination	
Rock Island Arsenal / AFGE LU 2119	Carpenter	28
	Drafter, mechanical	
	Electrician (alternate title: interior electrician)	
	Electrician, maintenance	
	Electronics technician	
	Lithographic Platemaker	
	Machine repairer, maintenance	
	Machinist (alternate title: precision machinist)	
	Molder	
	Ordnance artificer (gov ser)	
	Painter (const)	
	Patternmaker, wood	
	Pipe fitter (construction)	
	Plumber	
	Tool and die maker	
	Tool maker	
U.S. Army Corps of Engineers (Fort	Electrician, powerhouse	11
Peck Project, Big Bend Project, Fort	Electronics mechanic	
Randall Project)	Power-plant operator	
	Powerhouse mechanic	
U.S. Government Printing Office	Keyboarder/Proofreader	
	Offset Plate Maker/Prepress	
	Offset Pressperson	
	Bookbinder	
U.S. Military Apprenticeship Program	Army has 120,	112,459
(USMAP)	The Coast Guard has 21,	
	The Marine Corps has 237,	
	and The Navy has 88 occupations	
US Army Corps of Engineers – Grand	Electrician, Powerhouse	1
River Dam Authority, VINITA, OK,	Electrician, Substation	
	Hydroelectric-Machinery Mechanic	
	Industrial Engineering Technician	
	Instrument Technician (Utilities)	
	Line Maintainer	
	Machinist (Alternate Title: Precision Machinist)	

	Powerhouse Mechanic	
	Relay Technician	
	Telecommunications Technician	
	Testing & Regulating Technician	
US Department of the Interior	Construction equipment mechanic	710
	Electrician (alternate title: interior electrician)	
	Electronics mechanic	
	Maintenance machinist	
	Painter (const)	
	Substation operator	
	Wildland Firefighters	
US Navy Consolidated Brig	Animal Trainer	106
(California, South Carolina)	Baker	
	Barber	
	Cabinetmaker	
	Cook (Any Ind)	
	Furniture Upholsterer	
	Graphic Designer	
	Housekeeper, Com, Res, Ind	
	Landscape Gardener	
	Office Manager	
	Sheet Metal Worker	
	Welder, Combination	
USACE Seattle District/UPTO	Electrician, powerhouse	4
Apprenticeship Program	Power-plant operator	
	Powerhouse mechanic	
Watervliet Arsenal	Electronics mechanic	53
	Heat treater	
	Heating & air-conditioner install/ser	
	Machinist (alternate title: precision machinist)	
	Maint mechanic (any ind) (alternate title: industrial maintenance mechanic)	
	Maintenance machinist	
Western Area Power Administration	Electric meter repairer	15
(Joint Craft Training Committee,	Electric-distribution checker	
Desert SouthWest Region)	Electrician, powerhouse	
5,	Electrician, substation	
	Electronics mechanic	
	Electronics technician	
	Line maintainer (alternate title: high voltage electrician)	
	Line repairer	
National Guard (Indiana, Iowa,	Aircraft Armament Mechanic	6834
Missouri, Pennsylvania, and South	Aircraft Mechanic, Electrical	
Carolina)	Aircraft Mechanic, Plumb & Hydraulic	
-	Airframe & Powerplant Mechanic	
	Airframe Mechanic	
	Auto-Maintence-Equipment Servicer	
	Automobile Body Repairer	
	Automobile Mechanic (Alternate Title: Light-Wheel Vehicle Mechanic)	
	Aviation Support Equipment Repairer	

Avionics Technician	
Biomedical Equipment Technician	
Camera Operator	
Carpenter	
Computer Operator	
Computer Programmer	
Construction Equipment Mechanic	
Cook (Any Ind) (Alternate Title: Nutrition Care Specialist)	
Counselor	
Dental Assistant (Alternate Title: Dental Specialist)	
Electrician (Alternate Title: Interior Electrician)	
Electrician, Aircraft	
Electrician, Powerhouse	
Electronics Mechanic	
Emergency Medical Technician (Alternate Title: Health Care Specialist)	
Engineering Assistant, Mechanic Equip	
Environmental Analyst	
Exterminator, Termite	
Field Service Engineer	
Fire Fighter, Crash, Fire	
Fuel System Maint Worker	
Gauger (Petrol Prod)	
Hazardous-Waste Material Technician	
Heating & Air-Conditioner Install/Ser	
Instrument Mechanic (Any Ind)	
Laboratory Technician	
Legal Secretary	
Logistics Engineer	
Material Coordinator (Alt Titles: Automated Logistical /Unit Supply Specialists)	
Mechanic, Industrial Truck (Alternate Titles: Diesel Mech/Power-Gen Equip Rep)	
Medical Secretary	
Medical-Laboratory Technician (Alternate Title: Medical Laboratory Specialist)	
Non-Destructive Tester	
Nurse, Licensed Practical	
Office Manager/Admin Services	
Operating Engineer (Alternate Title: Heavy Construction Equipment Mechanic)	
Optician Dispensing	
Paralegal (Alternate Title: Paralegal Specialist)	
Pharmacist Assistant (Alternate Title: Pharmacy Technician)	
Photographer, Still	
Plumber	
Police Officer (Alternate Title: Military Police)	
Power-Plant Operator	
Purchasing Agent	
Radio Mechanic (Any Ind)	
Radio Station Operator (Alternate Title: Radio Operator/Maintainer)	
Safety Inspector/Technician (Alternate Title: Preventive Medicine Specialist)	
Telecommunications Technician (Alternate Title: Broadband Technician)	
Transportation Clerk (Alternate Title: Transportation Management Coordinator)	

Waste Treatment Operator	
Weather Observer-Meteorologist Tech	
Welding Technician	

b. DoL Portal

The DoL has established a targeted apprenticeship portal for recognized, accredited apprenticeships. It is a good point of departure for those agencies who may be considering an apprenticeship program. https://www.apprenticeship.gov/apprenticeship-industries/information-technology

C. Apprenticeships are strongly influenced by robust partnerships from a variety of sectors. Figure 3 below shows some of these partnerships in California that underlie the successful deployment of thousands of apprenticeships in a variety of fields



Figure 3. Apprenticeship landscape

d. A tracking system for all apprenticeship programs has been established by the NIST/NICE working group on apprentices. Updated continuously, it shows organizations that have adopted apprentice-ship programs and high-level information about each one. For agencies considering adoption, this data base allows exploration of similar programs either in the geographic vicinity, or the professional space of the agency. The following information elements are maintained:

- Program Name
- City
- State
- Link
- Point of Contact
- PoC Email
- Occupations
- Length of on-the-job learning program

- Related Instruction Hours (RTI)
- Certifications
- Active Apprentices
- Completed Apprentices
- Operating Locations
- Training Provider
- Educational Institution Name
- On-line Courses Used
- Entry Screening

In order to gain access to this system, a membership in the Working Group itself is required. Here are directions to do so: email to nicewg.app@list.nist.gov with the subject line: "Apprenticeship Sub-scribe", and with your full name and email address in the body of the message. This group meets the fourth Friday of every month at 11:00 a.m., Eastern Time.

e. The DoL has documented two case studies of apprenticeships; they give texture and detail to those potential adopters of an apprenticeship system, as well as a network of agencies that have done so.

Case Study #1: Centers for Disease and Control and Prevention

Description: The Centers for Disease Control and Prevention (CDC) is the leading national public health institute of the United States. Through a collaboration between the CDC and the U.S. DoL Employment Training Administration (ETA), the CDC developed an apprenticeship program in alignment with the CDC's Public Health Informatics Fellowship Program (PHIFP). The PHIFP provides on-the-job training for professionals to apply expertise in information science, computer science, and information technology to address current and future informatics needs. PHIFP is the first public health fellowship program designated as a DoL Registered Apprenticeship.

Prior to the partnership, the CDC had minimal knowledge of apprenticeship programs. It took approximately seven to nine months to develop the PHIFP. Once established, vacancies were advertised on USAJOB and job vacancy announcements listed on CDC.gov.

CDC does not use traditional competitive hiring authorities, but instead relies on the Excepted Service hiring authority. PHIFP requires a doctoral or masters-level degree due to the nature of the work required. The qualifying degree must be from an accredited academic institution in one of the following: public health, medicine, health care, or health-services research; computer science, information science, or information systems; statistics; epidemiology; or public health informatics or related discipline. While the program is competency-based, training is typically conducted over a two-year term. Once completed, arrangements may be made during the apprenticeship to place apprentices with State and Local Departments of Health. Benefits:

- Apprenticeship helped to respond to a critical need for succession planning within the CDC
- Allowed CDC to structure new training and innovative approaches to training for new responsibilities within the agency
- Forced newly structured training program to ensure consistency and uniformity regarding training and development of personnel
- Provided third party validation of CDC's internal training process

Challenges:

- General preconceived notions regarding concept of apprenticeship (e.g., associations with labor unions and building and construction trades)
- Aligning apprenticeship with federal pay system
- Verification of skills attainment

Case Study #2: Federal Bureau of Prisons

Description: The Occupational Education Program (OEP) in the Bureau of Prisons (BOP) was designed to help inmates acquire marketable skills in a wide variety of trades. BOP partnered with the DoL Office of Apprenticeship in 2015 to help develop a standard that all facilities could adhere to, allowing inmates to start and finish a program with limited interruptions because of transfers. Prior to the partnership with DOL, each correctional facility had its own processes, procedures, and structures. It took approximately a year and a half to two years to develop the national standards that BOPs facilities would use. This effort involved getting program information from both federal and private entities (e.g., UNICOR). OEP was established before the partnership with the DoL Office of Apprenticeship, so it also required training and communication efforts to prepare, support, and help all stakeholders understand the benefit of a national standards program.

The Related Training Provider varies from each institution, but is provided by either career civilservice vocational training instructors or through contracts with colleges and technical schools. The programs are usually time-based with a few hybrid models that typically consist of 2,000+ hours and may take three to four years to complete. Programs typically require an inmate to have a GED or high school diploma or concurrent enrollment in the Literacy Program. Wage progressions are standardized and documented in BOP's internal systems.

Benefits:

- Supports the development of skills necessary for entry-level employment in a given trade
- Supports a successful transition to reentry back to the community

Challenges:

- Receiving all the information from the different facilities/institutions
- Staff understanding of how creating a National Standard impacts each facility/institution

4. Possible Barriers to Federal Adoption

Drafted by Mike Prebil, New America

The benefits of apprenticeship are numerous and well-known. Employers that hire apprentices enjoy payroll savings relative to fully trained workers recruited through conventional channels, while apprenticeship's role-specific training also confers benefits of increased productivity and, anecdotally, stronger organizational culture and cohesion. Apprentices, for their part, benefit from the economic security of earning a progressive wage in an established career path, and diminished financial risks through low- or no-cost training and education. Conducting regular, productive work under mentor supervision also allows apprentices to build hands-on experience, professional networks, and social capital - all crucial but inequitably distributed economic advantages in America today.

Despite important expansion efforts over the past decade, apprenticeship participation in the United States remains low compared to other developed countries. American apprenticeships are concentrated in "traditional" occupations in the building trades, with low program availability in white- and new-collar professional occupations. Apart from the sizable US Military Apprenticeship Program, apprenticeships are rare in the public sector, and practically nonexistent in federal government agencies. Successive presidential administrations have championed apprenticeship expansion, with a particular focus on high-tech occupations. Federal agencies now have an opportunity to drive and lead this expansion themselves by implementing apprenticeships to train aspiring cybersecurity professionals, whose skills are almost universally in demand among government hiring managers.

A wide array of features and partnership options allow federal agencies to develop customized cybersecurity apprenticeships to suit their hiring needs. Agencies can adapt existing programs or start from scratch. Related coursework may be provided by higher education institutions or by industry vendors - or both. Indeed, the flexibility of apprenticeship can be daunting for new sponsors, all the more so because apprenticeship remains unfamiliar to many Americans. In general, federal agencies working to develop information security apprenticeships face two sets of challenges: administrative and operational.

The administrative challenges of cybersecurity apprenticeship relate to the capacities needed to establish an apprenticeship program. HR professionals and hiring managers must work together to identify appropriate occupations to be trained for using apprenticeship, catalog the skills needed for those occupations, establish the proper classification, and evaluate different program design options to suit the identified talent needs. This process can be particularly challenging in cybersecurity

professions, where skills analysis often demands familiarity with complicated technical jargon and concepts. Additionally, agency staff must dedicate some time to program registration: the process of submitting apprenticeship standards for certification by the US DoL. Each of these administrative challenges - program design, familiarization with technical terminology, competency mapping, and registration - can be mitigated through supportive collaboration with internal colleagues or with external intermediaries.

While the administrative challenges of cybersecurity apprenticeship primarily emerge when starting a program, the operational challenges relate to capacities needed to actually recruit and train successful apprentices, both immediately and in the long run. Fortunately, many of the operational challenges of apprenticeship are areas where federal HR professionals will already have significant experience and expertise. HR and hiring managers must implement best practices in recruitment and onboarding, especially if the apprenticeship strategy is aimed at improving agency diversity. Ideal candidates may be referred from relatively underutilized sources, such as community colleges, the military, community-based organizations or high school cybersecurity clubs, requiring new contacts and networks to be developed. As apprenticeships are learning processes, agency HR staff must adapt management practices to track learning progress as well as on-the-job productivity. HR staff may also need to develop training strategies to improve the ability of hiring managers to serve as effective apprentice mentors. Finally, because cybersecurity skills requirements evolve over time, HR professionals must implement processes for vetting program curricula and updating competency maps when necessary.

5. Available High-Level Models

If a government agency is interested in establishing an apprenticeship program to help strengthen the workforce pipeline for cybersecurity talent, it is possible to establish models that bypass the requirement to set up infrastructures to manage the apprenticeship program itself and its learning requirement and alignment to the DoL registered apprentice guidelines. Instead of establishing an apprenticeship office in the agency, an external organization (nonprofit or for-profit) can be designated as the apprenticeship nexus and be given resources to onboard, train, and prepare apprentices while they learn from agency mentors and train through formal education pathways or for certifications required on the job This external model is offered by a variety of companies, and more information can be found on their individual portals:

- Innovative Systems Group https://isglink.com
- Rightvarsity http://rightvarsity.com
- Smooth Stack https://www.smoothstack.com

Another model gaining traction in the federal space is a hybrid public/private model under which apprentices are taken in by federal agencies for a defined time frame, and then migrate to private sector jobs once they gain necessary skills in cybersecurity. One such program is called the cyber security talent initiative (CTI) https://cybertalentinitiative.org/ and is managed by the Partnership for Public Service

Yet another variation used by federal agencies leverages existing internship billets - extending them while the intern is gathering both academic and OJT training, and then transitions the position to a full time position. Such a hybrid model can help in situations where the internship model, with its limited tie and lack of tethering to a particular job, is well established.

6. Engaging the Hiring Manager

After establishing a small subcommittee of the National CyberWatch Center Working Group to organize questions, a focus group discussion was undertaken with Human Resource managers and hiring managers from federal agencies to explore awareness of the apprenticeship pathway and early indications of difficulties that may impede its long-term adoption in the government space. Represented in this discussion group were six federal agencies: US Army Corps of Engineers, Navy, Cybersecurity and Infrastructure Security Agency (CISA), 780th Military Intelligence Brigade, MITRE, and the State of Indiana.

Here are some reactions and suggestions from the discussion:

- There is uncertainty regarding the authorities that hiring managers need to do innovative things. Having the legal authority/Office of Personnel Management (OPM) support to take certain hiring or personnel management actions can be tricky. The real question is "what authorities/policies do HR managers need in order to implement the ideas that have come up?"
- There have been positive experiences with virtual training of intern/apprentice staff, and this seemed to be one of the challenges expressed by those with the military. This may signal an opportunity for shared practice between private and Federal service mid-level managers that are likely to mentor an apprentice
- Even though IT (2210 series) currently has special considerations for pay to make them competitive, it may need an update. Pay was a factor mentioned across the board and OPM may establish higher rates of basic pay - special rates - for a group by series, specialty, grade-level, and/or geographic area based on submission of a Special Rates Request https://www.opm.gov/policydata-oversight/pay-leave/pay-systems/special-rates-requests/
- DoL was thought by private industry as the entity to deliver starter funds to an interested federal agency; however, this is a non-factor with federal agencies. They are more distressed with the potential of training interns and paying for certificates just to lose them to the private sector
- To entice applicants, the current strategy by military call participants include budget requests to leadership for funding of several developmental positions at the 7/9/11/12 grade levels (described in the chat as "We also have the mission challenge of career ladders or frameworks providing opportunities in at the appropriate junior level, followed by milestone-based opportunities for promotion/development over a career.")
- The state of Indiana has a contract-to-hire mechanism for their State Earn and Learn program
- For retention, the apprentice can be required to sign a contract to stay with the agency for a certain number of years after training
- I'm surprised each agency is actively attempting to see how apprenticeship can help address their staffing needs. In addition, we always discuss how cybersecurity talent is leaving the public sector for the private sector. I never considered "in-fighting" between government agencies in which cybersecurity talent is enticed to leave one agency for another

- Two key barriers that are challenges for the better part of 10 years: clearances and getting OPM on board to relax 4-year degree requirements
- National CyberWatch Center should approach the NSF and suggest funding for a day long or half day workshop to be held in DC to meet with more of government folks to go more in depth on this subject. It seems like more time is needed for discussion
- Apprenticeship can be used by Government as a COVID-19 Pandemic Economic Recovery Relief (a palliative) hence, making it a higher priority item in the budget menu
- The idea of paying for the apprentices' accommodation and transportation so that they can "focus on work and their learning experience instead of focusing on bills" is very catchy. Incorporating that into an apprenticeship program can efficiently improve retention

7. Aligning Academic and OJT Requirements

The transition from educational programs to a job has always been a strong discussion item and point of agreement or disagreement between academics and representatives of the hiring organizations. One method to bridge this gap between the two is to align educational objectives with job skill requirements. An approach for such a strategy is outlined below:

Developing Job-aligned Training and Apprenticeships

Program Design

- Focus on high priority skills that are certification aligned, like network and infrastructure security, threat knowledge, compliance and operational security
- Prepare participants for company-specific application process
- Learning experience should combine fundamental concepts with multiple hands-on projects
- The content should ideally be taught by experts actually performing the job role to reinforce human, aspirational elements
- Interpersonal and employability skills guidance is as important to incorporate as technical skills to ensure learner success
- Reach a more diverse learner base by structuring the program with no prerequisites so that it is accessible for learners at all educational and professional levels
- Tie program to a clear, tangible career outcome for learners
- Identify skills that are in demand across the hiring landscape in case the training doesn't align to one specific job role (e.g., data literacy, emotional intelligence, critical thinking, and self-awarenes)

Instructional Design Practices

- Position learners for success by engaging in a backwards design process:
 - Start with clear learning objectives to frame the skills that should be learned and applied within and outside of the course
 - o Create meaningful assessments to help measure learner progress
 - Build learner knowledge through scaffolded instructional materials. Scaffolded learning will enable learners to effectively develop and build on what they know
- Implement mastery-based instructional design principles, first understanding your target learner and their motivation; in this case focusing on learners with less traditional educational and pro-fessional backgrounds
- Encourage active learning through activities such as in-video questions, low-stakes practice quizzes, and practice labs. This will help learners to develop and assess their mental models so that

they are actively processing and applying what they've seen in videos and read

• Communicate immediate and elaborate feedback to learners

Jobs for the Future Essentials for a High-Quality Pre-Apprenticeship Program

- Transparent entry and success requirements
- Alignment with skills taught by local employers and high-quality apprenticeship programs
- Culmination in one or more industry recognized credentials
- Development of skills through hands-on and work-based learning
- Offering of academic, career exploration, and wraparound support
- Transition into a registered Apprenticeship or other high quality apprenticeship program

In California, the talent pipeline for non-traditional learning pathways includes a creative effort to include individuals who might be missed though the more traditional channels. Components include: Obstacles, limitations, and challenges faced by the education community/industry/public sector agencies in the cyber workforce effort

A vigorous case for apprenticeships to help solve the cyber workforce capability and skill crisis in the state

The following phase define the model:

- Recruiting phase
- Pre-apprenticeship phase
- Registered apprenticeship phase
- OJT phase
- Prepared workforce
- Two initial certificates are ready: cybersecurity for Small/Medium business and Life Sciences

8. The Value Proposition

Public Sector Apprenticeships

Apprenticeship is an industry-driven, high-quality career pathway where employers can develop and prepare their future workforce, and individuals can obtain paid work experience, classroom instruction, and a portable, nationally-recognized credential. Apprenticeships are a customizable, flexible, and proven business-driven model for developing workers. Apprenticeships offer a multitude of benefits for employers including:

- Recruiting and developing a diverse and highly-skilled workforce including women, minorities, and veterans
- Improving productivity, profitability, and the bottom line
- Increasing staff loyalty and retention of workers, during and following the apprenticeship
- Creating flexible training options that ensure workers develop the right skills
- Minimizing liability costs through appropriate training of workers

Apprenticeships are not just for the private sector. Many federal government agencies, including DoL, U.S. Department of Health and Human Services, U.S. Department of the Treasury, and the U.S. military have apprenticeship programs. Federal agencies can use apprenticeship as an effective human resources strategy to recruit quality candidates, train employees to the specific needs of agencies, and retain a highly-skilled workforce. Apprenticeship can be used within the federal job series and pathways structure, to upskill the current workforce and to accelerate the productivity of new hires. Through the use of standardized training curricula, which fit readily into existing agency training programs, Federal Agencies can ensure their employees have a comprehensive understanding of both the practical and theoretical components in mission-critical occupations.

Establishing a widespread apprenticeship approach throughout the public sector can also:

- Provide an opportunity for the federal government to lead by example. Encouraging the creation and expansion of apprenticeships has been a cornerstone of past and present administrations. Expanding public sector apprenticeships provides credibility when encouraging organizations to embrace apprenticeship
- Provide a solution to the cybersecurity workforce skills gap. Globally, organizations report a shortage of cybersecurity skills within their organization. Projections suggest a cybersecurity workforce shortage of 1.8 million by 2022. This shortage is particularly acute within the federal government. The federal government depends heavily on its cybersecurity workforce, supplemented by contractors. The Presidential Executive Order on Strengthening the Cybersecurity of Federal Networks and Critical Infrastructure directs various federal agencies to provide a report to the President with findings and recommendations regarding how to support the growth and sustainment of the Nation's cybersecurity workforce in both the public and private sectors. The report recommends "building on and strengthening hands-on, experiential and work-based

learning approaches - including apprenticeships, research experiences, co-op programs, and internships." This recommendation is consistent with Executive Order 13801, Expanding Apprenticeships in America.

 Increase diversity. Apprenticeships can increase the diversity of public service workers, as increased emphasis is placed on "learning by doing" instead of an exclusive focus on academic learning. Additionally, they provide a pathway to quality employment for workers, particularly those with multiple barriers to employment

A recent report (CTA2020) provided a compelling case for the value of apprenticeships using a Return on Investment table and by comparing Apprenticeships against the more well known Itnerships and Co-op pathways :

ROI Comparison: Work Based Learning Options						
	Apprenticeship	Internship	Со-ор			
Active Enrollment in a Degree Pathway Required	NO	YES	YES			
Average Length	12-24 months	3 months (1-2 rotations)	6 months (2-3 rotations)			
New Hire Conversion Rate	91%	46%	28%			
Retention Rate after 1 year	91%	70.6%	47.3%			
Talent Acquisitions Cost (campus recruiting, sign-on bonuses, housing, relocation, etc.)	\$	\$\$\$	\$\$\$			
Talent Supply Chain	Universities, Community Colleges, Bootcamps, Veterans, Career, Re-inventors, Returnships, incumbent Workforce, High Schools, NGO's	Universities	Universities			
Federal Training and Wage Offsets	YES	NO	NO			
Rate of Diverse Hires	41.8%**	While diversity hiring data is unavailable, according to NACE Trends and Predictions, 81% of employers have diversity recruiting efforts.				

*Source: 2018 Internship & Co-op Survey, National Association of Colleges and Employers **Source: 2016 Urban Institute report on all RAPIDS states illustrates people of color

9. Seeding the Way: Pilot Proposals to Agencies

The discussions among the Working Group members revealed a willingness to develop pilot programs with federal agencies and other partners interested in exploring the apprenticeship model in the cybersecurity workforce arena. Two such pilots are under way in the fall of 2020. Each has a different trajectory to implementation, and all would add to the understanding of the benefits of apprenticeship models and hopefully initiate additional programs throughout the government space.

Here are summary write ups of each pilot effort.

a. HBCU Invitation to partner (Girish Seshagiri)

An Invitation to Partner with South Carolina Historically Black Colleges and Universities to Design and Launch Cybersecurity and IT Degree Apprenticeship Cohorts

We invite you to partner with SC HBCUs to design and launch degree apprenticeship cohorts to solve Cybersecurity and IT skills shortage. This is a terrific opportunity to be part of this SC effort of national importance, be leaders in this space, and help develop degree apprenticeship programs in IT/ Cybersecurity occupations.

South Carolina State University, a premiere HBCU and Ishpi Information Technologies, Inc., a fastgrowing defense contractor co-sponsored an HBCU Cybersecurity Workforce summit in Orangeburg in February 2020. The summit brought together more than 60 participants including senior executives from SC employers, SC HBCUs, state and local economic development organizations such as Charleston Regional Development Alliance (CRDA) and Apprenticeship Carolina, and representatives from DoL, IBM, National Initiative for Cybersecurity Education (NICE), and others.

A key outcome of the summit is the formation of a core group of stakeholders with a mission to plan, design and launch employer-led Cybersecurity/IT degree apprenticeship cohorts at SC HBCUs by fall/winter 2020. The HBCU Cybersecurity Workforce core group under our joint leadership has met number of times with active participation of HBCU faculty and supported by others including Apprenticeship Carolina and Charleston Regional Development Alliance. We have also met with DoL and IBM representatives with substantial experience in registered apprenticeship. The group surveyed employers in SC and received positive responses. The responding employers identified four (4) hard-to-fill work roles in IT and Cybersecurity. The South Carolina HBCUs are currently mapping their IT/Cybersecurity curriculum to these work roles using the Competencies, Knowledge, Skills, and Ability (KSA) of the NICE Workforce Framework. Once fully developed with employer partnership, this Degree Apprenticeship Program will be one of its kind in SC and in the nation. Benefits to both employers and apprentices include:

- creation of a pipeline of entry level Cybersecurity and IT workforce with readily employable local talent with demonstrated competencies
- increased workforce diversity
- reduced recruitment costs and improved retention and loyalty
- enhanced career pathways to high wage, high technology Cybersecurity and IT occupations
- apprentices mentored by experienced staff and hired upon successful completion of apprenticeship to fill available jobs in Cybersecurity and IT
- the opportunity for employers to shape the workforce in their industry while giving workers an opportunity to learn, produce high-quality work, and earn wages

We will follow up with phone call to discuss details, answer questions and check your availability for a meeting with the SC HBCU Cybersecurity core group.

Dr. Nikunja Swainswain@scsu.edu(803) 347-671Chair, Department of Computer Science, South Carolina State University

Girish Seshagiri Girish.seshagiri@ishpi.net (571) 286-2759 Director, Board of Directors, Ishpi Information Technologies, Inc.

b. ISG and CompTIA to DoL (Keith Kregg and Tony Marshall, Amy Kardel)



SUBJECT: Department of Labor Cybersecurity Apprenticeship Program Proposal

1. OBJECTIVE: Design and implement a Department of Labor (DOL) and Innovative Systems Group (ISG) cybersecurity apprenticeship program that features Transitioning Service Members (TSM); Veterans who provide DOL cybersecurity services; and produce experienced cybersecurity professionals.

2. BACKGROUND: The current and growing cybersecurity talent shortage can be addressed through a cybersecurity apprenticeship model that systematically combines foundational education, training, certification and supervised work experience.

3. WORKFORCE: TSM's provide an ideal population for cybersecurity careers. Transitioning Veterans

collectively have the aptitude, attributes and security clearances to seamlessly enter cybersecurity careers, and are specifically suited for federal agency assignments that are in high demand.

Cybersecurity Apprenticeship Model						
Screening	Pre-Apprenticeship (Preparation)			Apprenticeship (Experience)		
Selection	Education	Training	Certification	Performance		

4. PRE-APPRENTICESHIP (Preparation): The pre-apprenticeship period includes integrated foundational education, virtual simulation training, and globally recognized cybersecurity certifications. This phase, informed by DOL requirements, produces cybersecurity technicians who are ready to work upon arrival. This full-time preparation is conducted over 4-5 months and prepares candidates to move directly into positions providing technical cybersecurity services.

a. Education: Foundational education provides the underlying knowledge needed to understand and operate in the cybersecurity sector.

b. Training: Performance-oriented, hands-on training, prepares apprentices to perform functions at the beginning of their work experience.

c. Certification: Cybersecurity certifications authenticate a broadly accepted level of knowledge needed to operate and perform cybersecurity operations.

5. APPRENTICESHIP (Experience): The cybersecurity apprenticeship program (CAP) includes 24 months of supervised cybersecurity performance in support of DOL requirements. It also includes continued education and certifications. During this period, the apprentices are ISG employees, providing services in support of DOL. This system is in place and works well for the state of North Carolina and we are excited to get it started at the federal level.

a. Performance: Supervised work experience; delivering services while learning.

b. Advancement: Continued education, training, and additional certifications.

c. Career: Upon completion of the apprenticeship the participant is available to move into the DOL workforce or across the spectrum of cybersecurity opportunities.

6. APPRENTICESHIP PLAN (DOL and ISG plan of action):

a. Skill Requirements: Identify requirements and positions in order to build the education, training, certification and experience model.

b. Organization: Define the work environment and location in order to recruit, prepare and support the DOL CAP model. (Pilot of 12 participants in cohort 1)

c. Agreement: Jointly agreeing on skills, work environment, and resources. Include foundational education, training, certification, work experience, and funding.

ISG, 8480 Honeycutt Drive, Raleigh, North Carolina 27615 | 919-844-8075

10. Recommendations to NSF

- Support the two pilot implementations under way and create additional ones
- Develop explicit linkages to Scholarship for Service (SFS) schools with existing apprenticeship programs or interested in building such programs, and provide these schools with support on matching students with federal agencies interested in apprenticeships; the community colleges involved in the NSF supported C5 program would be an additional focus for this support
- Continue the management of the Apprenticeship Working Group through monthly meetings, discussions, and shared activities aimed at promoting the concept of apprenticeships
- Explore ways to assist the American Association of Community Colleges (already on the Working Group)
- Broaden the information and networking regarding cybersecurity apprenticeship models in the community college community
- Deploy a day long workshop to be held in DC and virtually to meet with more government hiring officials and c-level leaders to go more in depth on the benefits of apprenticeship. A specific target would be the authorities/policies needed in order to implement apprenticeship efforts

11. NCC Working Group Membership

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12. References

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- Cyberspace Solarium Commission
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- NAPA Great Initiative Report on Privacy and Security https://www.napawash.org/uploads/Election_2020_Data_Security_and_Privacy_.pdf
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- California Cybersecurity Essential Workforce Youth Pre- and Registered Apprenticeship Talent Pipeline (CEWYA) Strategy and Framework https://ictdmsector.org/wp-content/uploads/2020/09/The-California-Cybersecurity-Essen tial-Workforce-Pre-and-Registered-Apprenticeship-Pathway-Talent-Model-GM3b.pdf
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